Kata in the Classroom
Instructions

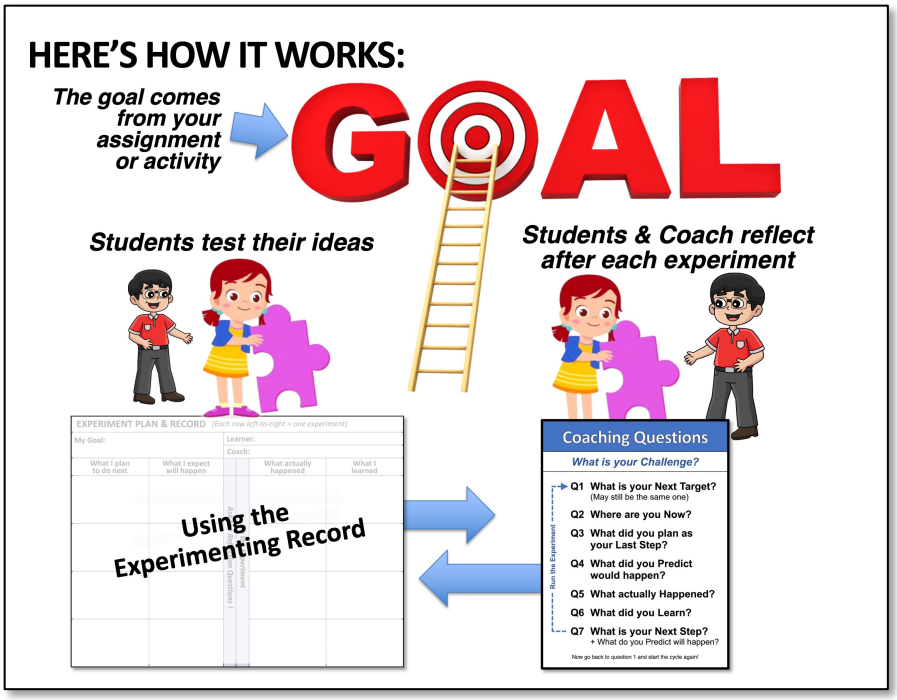
THE COACHING/REFLECTION QUESTIONS - *A Dialogue for Teaching Scientific Thinking*

The Coaching/Reflection Questions are a short, structured series of questions that mirror a scientific-thinking pattern. Educators use them — and eventually student teams can use them for themselves — to help learners practice a scientific approach to working toward goals. The questions can be used in any classroom as a guide for conducting regular reflections. Regularly working through them encourages iterative thinking, supports a growth mindset, and helps establish a safe, engaging and collaborative learning environment.

Helping students achieve goals, by coaching them in practicing scientific thinking.

1) What are the Coaching/Reflection Questions?

This sequence of structured questions is used repeatedly and frequently by the coach, to help students follow and internalize an effective scientific-thinking approach to goals. The questions provide you with a short, easy-to-use script for reflecting on the last step and planning the next step. They also give the educator insight into how a student, or student team, is thinking, so the educator can provide appropriate, situational feedback, which is important for effective practice of a new skill pattern. The questions mesh with the student's Experimenting Record, and the two routines are often used together.



The Coaching/Reflection Questions and the Experimenting Record are often used together.

The sequence of questions is:

Questions for the educator to ask student teams

Coaching Questions

What is your Challenge?

Run the Experiment

Q1 What is your Next Target?
(May still be the same one)

Q2 Where are you Now?

Q3 What did you plan as your Last Step?

Q4 What did you Predict would happen?

Q5 What actually Happened?

Q6 What did you Learn?

Q7 What is your Next Step?
+ What do you Predict will happen?

Now go back to question 1 and start the cycle again!

Questions for student teams to ask themelves

Reflection Questions

What is our Challenge?

Run the Experiment

Q1 What is our Next Target?
(May still be the same one)

Q2 Where are we Now?

Q3 What did we plan as our Last Step?

Q4 What did we Predict would happen?

Q5 What actually Happened?

Q6 What did we Learn?

Q7 What is our Next Step?
+ What do we Predict will happen?

Now go back to question 1 and start the cycle again!

The questions are usually printed on cards, and often also posted in the classroom, for easy reference. These printable cards can be downloaded on the *Kata in the Classroom* website:

2) How to Use the Coaching/Reflection Questions

Print out question cards and keep one on your clipboard for student conversations. Give the students a card, too. You can also post the questions visibly if you like. Having the questions handy helps with the dialog and development of a thinking habit.

Think of asking the questions as a pause, to reflect on the student's last step, review their plan for the next step, and give feedback, as necessary, on their approach. Ask the questions after a student team takes a step, or at any reflective moment. Ask the questions verbatim - exactly as written on the card - to build familiarity in the flow of the questions, so the pattern becomes second nature for both coach and student.

The Coaching/Reflection Questions can also be embedded into small group instruction and student led peer-to-peer work. Eventually students should begin to internalize the questions and ask them of themselves, unprompted. When you hear students say, *"I know, I know…"* and start answering the questions on their own, you'll know a habit is taking hold.

During each coaching cycle:

- Hold the question card in hand, and ask the questions one at a time, in order.
- What you need to get to as you go through the questions is identifying and agreeing on the student's next step — not a list of steps, just the very next one. Once the next step is clear, that coaching cycle is nearly done. (See "Threshold of Knowledge" below.)
- At that point the student needs to make a prediction on their Experimenting Record, and can then proceed with the next step, which you can review the next time you ask the questions.

It is perfectly acceptable for the student's next step to be a single and small step, as long as your coaching cycles are frequent. You can make astonishing progress toward goals this way, because unnecessary time spent speculating is reduced.

Frequent coaching cycles and taking small steps gives you the leeway to let students make some mistakes and learn from them. One aspect of good practice is that we learn through our struggles and errors. Those teachable moments are an opportunity for constructive feedback and advancing the student's practice.

The five question card is not just a practice routine, but an outline for how to tell a scientific-thinking story. Through the dialog, the educator and the student focus on the "story" that's unfolding, end ensure that it proceeds scientifically.

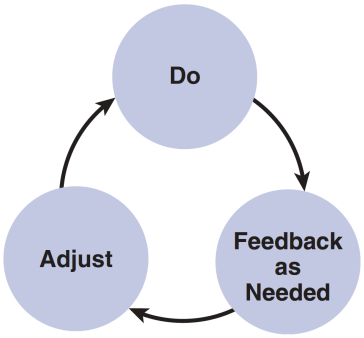
Part of the dialog is structured—the questions—and part is situational—the feedback you give the student. The sequence of questions is scripted, but your feedback depends on what you discern about the student's current thinking. It's like a sports coach asking an athlete to take a few swings or a music teacher asking a student musician to play a few bars, so they can observe what the student is doing. Of course, you can also ask additional clarifying questions to trigger

or probe the learner's thought process, gain more detailed information, and help identify the current threshold of knowledge.

Once you have listened to the student respond and gotten a sense for their current thinking, you might give a corrective input tailored to the needs at that point in time. Note that you don't have to give corrective feedback every time, that's your judgement. The Coaching/Reflection Questions are not about audit and compliance. It's part of a reciprocal, collaborative relationship that creates a learning experience for both of you. Each effort to give feedback to the student is practice for the educator, and each effort to act on the educator's feedback is practice for the student.

- The student and educator are engaged in a joint process of discovery around striving to reach the next target condition. No one knows exactly what will be learned from the next experiment.
- The student and educator are each practicing a routine for their role.

There is no need to overload the student with more than one or two points of feedback in any coaching cycle, because reflection takes place frequently. Think about the one thing you think the student should practice next. Rinse, repeat.



The cycle of feedback and adjustment

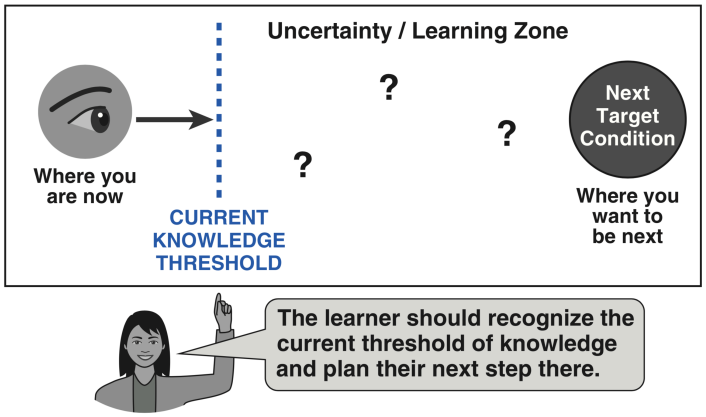
Using the question card is a good start, but does not yet make one an expert scientific-thinking coach. It takes a little practice master the thinking patterns behind them. You might look for opportunities to practice the questions beyond your student coaching cycles. For example, you might try using them during meetings or other conversations to strengthen your familiarity with the pattern. As your coaching skill grows, you'll be able to better discern where your students are in their thinking and what kind of feedback will help them most.

Watch for the Student's *Threshold of Knowledge*

The Coaching/Reflection Questions are nested—each one builds on the previous one. Make sure the student has a good understanding related to the current question before moving to the next question. When the student's answers become vague or imprecise, it's often a sign that you've found their current threshold of knowledge. When you get to the point where the student doesn't seem to know (students won't usually say outright, "I don't know," so you'll

need to sense it), then go directly to question four, saying, *"Don't worry if you don't know; what is your next step to find out?"* Once the current knowledge threshold has been found, there's no need for a lot of additional speculative discussion. Have the student pull out their Experimenting Record and plan their next step/experiment.

A knowledge threshold is the point where we move from facts into assumptions, and that's usually where the next experiment should be done. There's always a current knowledge threshold, and finding it helps you and the student see what the student's next step should be. A good coaching question to have in mind in this regard is, *"What do you need to learn next?"*



Have your students experiment at their knowledge threshold

Recognizing the current knowledge threshold can be tricky because the student naturally wants to answer your questions, rather than saying, "I don't know." Ideally you'd like the learner to say, *"We're at a knowledge threshold here. At the moment I don't know the answer, and I don't want to jump to conclusions. Here is the next step (experiment) I intend to take to help me get the facts and data we need to learn more."*

You can encourage this mindset by modeling curiosity and reinforcing that not knowing is not a problem — it's the doorway to learning. Scientific thinking depends on the ability to acknowledge uncertainty so we can identify what to test next. You might say:

- *"It's perfectly fine if you don't know. Just tell me how you plan to figure it out."*
- *"How could we find that out?"*

Since learners may hesitate to admit they don't know, you'll often spot a threshold not from what they say explicitly, but from how they answer. Develop an ear for when the learner is responding imprecisely, with generalizations, assumptions, opinions, or speculation. When the learner does any of the following, it may indicate that a knowledge threshold has been reached:

- The student uses vague language: *"I think… probably… maybe… could… most likely… well… on average… 90 percent of the time."*
- The student refers to outdated data.
- The student seems overly confident, acting like something must be true without being able to explain why.

At any point in your Coaching/Reflection Question dialogue, you may become aware of the learner's knowledge threshold. Rather than continuing with assumptions and opinions, you can go right to question 4 and agree on the next step by asking, *"What is your next step to find out?"*

Have the student define and take that step as soon as possible, and use what is learned to see further. This reinforces the principle that we advance through experimentation, not conjecture. Help your students view knowledge thresholds in a positive light, by encouraging them to:

- Acknowledge the threshold. Remind them: there's always a knowledge threshold!
- Capitalize on the knowledge threshold. Celebrate finding it. The moment you spot it, it's time to stop, run an experiment, and see further. Don't waste energy debating speculative answers — focus on designing the next learning step.

With practice, your students may not only start to see the knowledge thresholds all around them, they may even begin to enjoy them as a normal part of life that helps us find a path to our goals.

Don't Take Over the Problem Solving, Help the Student Practice the Problem-Solving Process

You're not asking the questions to direct the student to particular solutions (though it can feel that way to the student), but to guide them on scientific-thinking procedure. The content of what the student opts to do next should often spring from their process of experimentation; from what they learned in their last experiment.

Neither you nor the student knows in advance which steps will lead to the next target condition. However, once you have listened to the learner's responses, you can be directive about the learner's procedure for the next step. You're guiding how they think and proceed, not what solutions they should pursue. (That said, there are occasions where you might help a student get unstuck by suggesting, *"Maybe you could try..."*)

It's normal to wrestle with the boundary between coaching and telling. It can be hard to keep from jumping in with your own thinking about potential solutions, or to not ask questions that lead the student toward your ideas. Keep in mind that the structured questions are focused on getting the student to practice thinking scientifically for themselves. Your job is more to help them see when their problem-solving approach is straying from sound scientific process — but not to take over the problem-solving itself. *"Let's see what happens and what we learn,"* can be a good thing to say to the student, to keep the focus on experimentation and learning, not on jumping ahead to presumed solutions.

The Role of Encouragement

When someone is practicing a new set of skills it's normal to feel a sense of discomfort, because we're engaged in weaving some new neural pathways. At the beginning, practicing often feels awkward, slow, unnatural, stiff, uncomfortable, and difficult. These feelings are actually a good sign, because they indicate the students is learning something new. Keep going.

This makes encouragement, done right, an important element of coaching. For a beginner it's important to derive motivation from periodically feeling that he or she is successfully moving closer to the target condition and getting better at scientific thinking. Give specific praise that emphasizes new learning and growth, not just effort. For example, you might say:

- *"You're not there yet, but you're on the right track,"*
- *"Look how your work has changed since two months ago. It's clear you're getting the hang of this."*

Each small win builds the student's confidence and reinforces the belief that they can achieve their goals. The student becomes more motivated to pursue difficult goals and more confident that they will be able to achieve them.

3) Why Practice Using the Coaching/Reflection Questions?

By regularly asking the Coaching/Reflection Questions you are working to keep the student's practice in the corridor of good scientific thinking, so that, over time, the student develops a natural reflex of thinking that way. You're correcting practice errors before they have a chance to become habits. Three purposes of practicing the Coaching/Reflection Questions are:

- **To help you develop your students' scientific-thinking skills.**
  The sequence of questions are prompts that help you see how a student is currently thinking, which enables you to give feedback that keeps them practicing a scientific approach.
- **To identify the student's current knowledge threshold.**
  The questions help uncover where the student's current understanding ends, and ensure the student is designing a good next experiment that helps them see further.
- **To help develop yourself as an effective coach of scientific thinking.**
  Using the questions regularly helps you refine your own coaching skills and strengthens your ability to guide others in developing this mindset.